PATENT SPECIFICATION

(11) **1 500 763**

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(54) DRIVE TRANSMISSION

(71) We, SUNDSTRAND CORPORATION, a corporation organised and existing under the laws of the State of Delaware, United States of America, of 4751 Harrison Avenue, Rockford, Illinois 61101, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to drive transmissions comprising a pair of spaced members with facing annular grooves providing a toroidal space. Traction can be transmitted from one such member to the other by means of rollers in frictional engagement with the grooves.

The invention provides a drive transmission comprising a pair of spaced members with facing grooves for independent coaxial rotation about a drive axis, a plurality of rollers rotatable about a roller axis and in rolling frictional engagement with both facing grooves, an independent mounting for each roller providing rocking movement to tilt the roller axis, and means for directing the roller axes to intersect the drive axis, which means includes a cam follower extending axially of each roller and an elongate cam surface associated with each cam follower, the roller mountings each including an arm for carrying the roller, and an extensible rod movable along a rod axis intersecting the roller axis the arm being mounted on the rod for rotation about the rod axis.

The operation of the cam, at its simplest, ensures that the drive output is at the same speed as the input. By hydraulic control of the roller mountings, it is possible to vary the ratio of the output to input speeds.

The invention is illustrated by the drawings, of which:

Figure 1 is a longitudinal section of a drive transmission;

Figure 2 is a cross section on the line 2—2 in Figure 1;

Figure 3 is a section on the line 3—3 in Figure 2; and

Figure 4 is a section on the line 4—4 in Figure 2.

With reference to Figure 1, the transmission has a cylindrical shell 10 with a pair of end plates 11 and 12 fitted to opposite ends and secured by screws 14 to rings 15 welded to the shell 10. A pair of spaced members 20 and 21 are positioned within the casing and are independently mounted for coaxial rotation about a drive axis D (Figure 2) by respective bearings 22 and 23 supported by the casing shell 10. The member 20, a drive member has a cylindrical extension 25 extending through a central opening in the end plate 11 and splined for attachment to an input shaft (not shown). The member 21, a driven member, has a cylindrical extension 26 extending outwardly through the end plate 12 and is splined for connection to an output shaft (not shown). The members 20 and 21 have facing grooves 30 and 31, respectively, each being part of a torus and partially circular in cross section as seen in Figure 1.

A plurality of drive rollers 40, 41 and 42 are positioned between the members 20 and 21 and with the curved peripheral surface of the rollers in frictional engagement with the grooves of the members. Thus rotation of the drive member 20 imparts rotation to the rollers about a roller axis R (Figure 1) which, in turn, impart rotation to the driven member 21. The rollers 40, 41, 42 each have a radius the same as that of the cross-sectional curvature of the grooves 30 and 31.

The bearing 23 is urged to the left in Figure 1 by fluid pressure acting on pistons 43 to urge the member 21 toward the member 20 and squeeze the drive rollers 40, 41, 42 therebetween.

Each of the drive rollers 40, 41, 42 is mounted for movement along the grooves 30 and 31. Motion inherent in a toroidal drive causes rocking or precessing of the drive roller to a position either clockwise or counterclockwise for the roller 40 as shown

roller axis is anchored at the spherical end 50a, the roller axis will be pivotedly inclined relative to spherical end 50a. At the place where the roller 40 and drive member 20 engage each other the two surfaces move in exactly the same direction if slippage at the contacts is to be prevented, but the velocity vectors for rotation of each member about its axis are not congruent. Thus, there is a component of velocity and a resultant frictional force which tends to pivot the roller about the rod 51 outwardly on the drive member 20 and inwardly on the driven member 21. Pivoted movement of the roller responsive to such frictional force establishes a drive ratio which is different from one to one, and the speed of the driven member is increased relative to the speed of the input.

The movement of the roller 40 about the axis of the rod 51 to change the drive ratio also results in motion of the cam follower spherical end 50a along the inclined cam slot 170 to return the axis of the roller to intersect the axis D in a steady state condition. That is, the pivoted movement of the roller 40 about its axis produces motion of spherical end 50a along slot portion 170a, and the roller axis moves to a position intersecting axis D.

The common control pressure applied to the hydraulic control means associated with each of the drive rollers positions the drive rollers for equal load division therebetween. The fixed cam slots coact with the cam followers associated with the rollers to assure a specific drive ratio for each discrete position established by the hydraulic control means.

WHAT WE CLAIM IS:—

1. A drive transmission comprising a pair of spaced members with facing grooves for independent coaxial rotation about a drive axis, a plurality of rollers each rotatable about a roller axis and in rolling frictional engagement with both facing grooves, an independent mounting for each roller providing rocking movement to tilt the roller axis, and means for directing the roller axes to intersect the drive axis, which means includes a cam follower extending axially of each roller and an elongate cam surface associated with each cam follower, the roller mountings each including an arm for carrying the roller, and an extensible rod movable along a rod axis intersecting the roller axis, the arm being mounted on the rod for rotation about the rod axis.

2. A drive transmission as defined in claim 1 including hydraulic control means associated with each roller mounting for positioning the roller.

3. A drive transmission as defined in claim 2 wherein the hydraulic control means include a cylinder with a piston therein, and a part-spherical joint connecting the piston to the rod to permit shift of the rod relative to the piston.

4. A drive transmission as defined in claim 3 including passages for directing a control fluid to the cylinder to exert fluid pressure on the piston in opposition to a tangential load force exerted on a roller by frictional contact with the spaced members, and passages for directing lower fluid pressure against a section of the part-spherical joint to maintain the sections of the spherical joint in engagement.

5. A drive transmission as defined in any preceding claim wherein each elongate cam surface is part of a slot receiving the associated cam follower, the slot having sections at either side of its midpoint extending at equal and opposite angles to the drive axis.

6. A drive transmission as herein described with reference to the drawings.

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1500763 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

Sheet 1

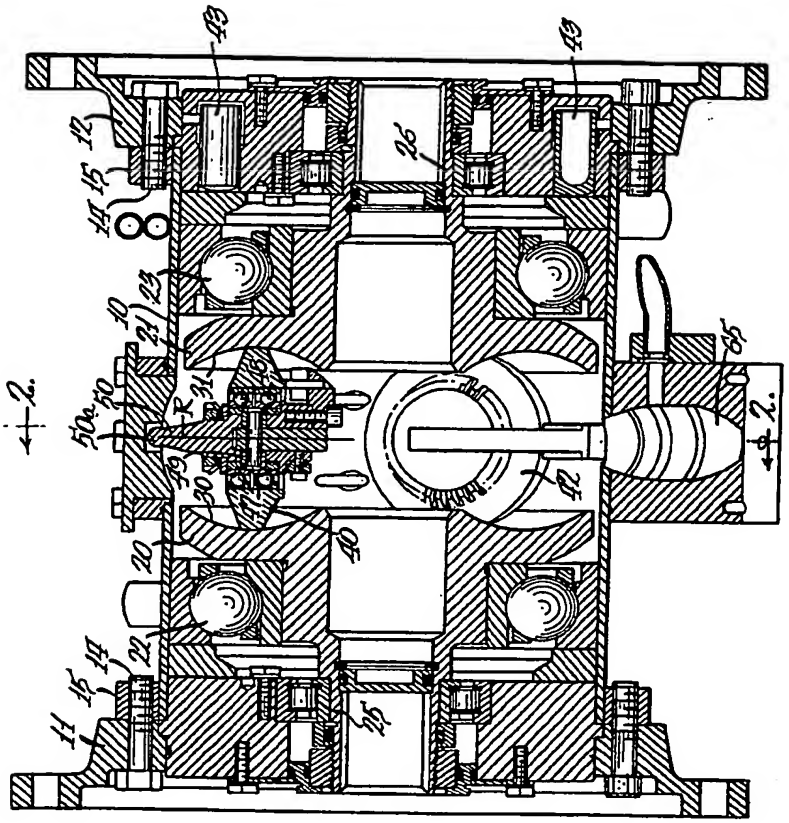

FIG. 1.

1500763 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

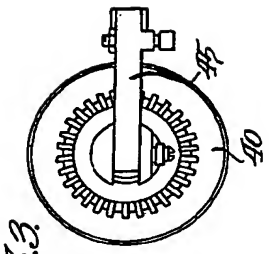

FIG.3

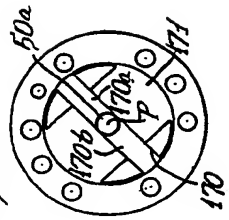

FIG.4

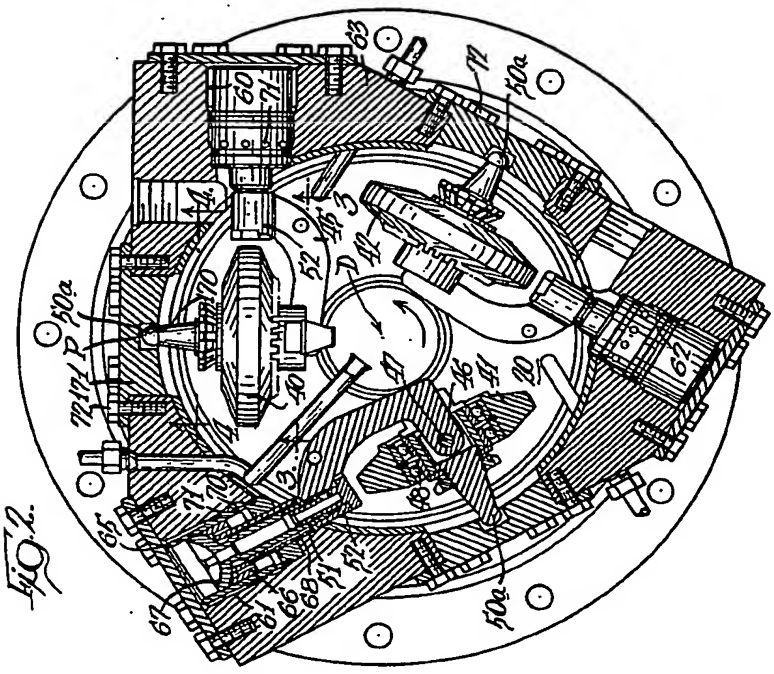

FIG.2